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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/650,415	08/29/2003	Hyung-Suk Jung	5649-1123	6569

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EXAMINER	
SARKAR, ASOK K	
ART UNIT	**PAPER NUMBER**
2829	

DATE MAILED: 06/24/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Offic Action Summary	Application No.	Applicant(s)	
	10/650,415	JUNG ET AL.	
	Examiner	Art Unit	
	Asok K. Sarkar	2829	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 August 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-31* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-31* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *29 August 2003* is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claim 31 is rejected under 35 U.S.C. 102(e) as being anticipated by Yu, US 6,566,205.

Yu teaches a method for treating a high dielectric layer of an integrated circuit device, comprising nitriding to provide a nitride profile concentration in the high dielectric layer that is greater adjacent to the polysilicon/high dielectric layer interface than adjacent to a silicon/high dielectric layer interface with reference to Figs 4 and 6 and associated descriptions in between column 2, line 43 and column 3, line 34.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 1 – 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Halliyal, US 6,451,641 and Yamamoto, US 2002/0153579 in view of Yu, US 6,566,205; Rodder, US 6,251,761 and Raaijmakers, US 2003/0234417.

Regarding claims 1 – 6, 8, 9, 11 – 15, 17 – 22 and 24 – 30, Halliyal and Yamamoto teach a method of forming high dielectric layer over a silicon substrate by depositing a layer selected from the group consisting of a hafnium oxide layer and a zirconium oxide layer on the silicon substrate; and depositing a Group 3 metal oxide layer over the layer to form a multiplayer nanolaminate of a dielectric layer (see detailed

description of Halliyal in columns 3 – 7 and especially in column 7, lines 1 – 7) and (see detailed descriptions in different embodiments by Yamamoto and especially Fig. 3).

Halliyal and Yamamoto fail to teach the (1) nitridation treatment of the dielectric layer and its associated conditions and the post treating of the high dielectric layer by (2) oxidation and (3) annealing and its associated conditions.

Regarding element 1, Yu teaches the process of nitriding high K gate dielectric by plasma nitridation and by other nitridation methods in column 3, lines 15 – 35 for the benefit of achieving lower operating gate voltage and to neutralize fixed charges in the dielectric in the title and abstract of the article.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to modify Halliyal and Yamamoto and apply a nitridation treatment for the high K gate dielectric by plasma nitridation for the benefit of achieving lower operating gate voltage and to neutralize fixed charges in the dielectric as taught by Yu in the title and abstract of the article.

Regarding element 3, Yu further teaches that nitridation is followed by an annealing process in column 1, lines 52 – 56. Rodder teaches the benefit of annealing the nitrided high-K dielectric stack at in nitrogen atmosphere at a temperature between 750 – 1100^{0}C for the benefit of reducing the leakage and providing a robust surface in column 4, lines 42 – 52.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to modify Halliyal and Yamamoto and apply an annealing process for the nitrided high-K dielectric stack in nitrogen atmosphere at a temperature between

750 – 1100^{0}C for the benefit of reducing the leakage and providing a robust surface as taught by Rodder in column 4, lines 42 – 52.

Regarding element 2, Raaijmakers teaches that for multilayered high – k dielectric materials (paragraph 36 – 39) needs an anneal step (paragraph 44) and also an oxidation step in various oxygen atmospheres of dry and wet oxidations and various sources of oxidation (see paragraphs 57 and 58) at a temperatures between 700 – 900^{0}C in paragraph 45 for the benefit of providing a better quality for multilayered high – k dielectric materials in paragraphs 9 – 11.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to modify Halliyal and Yamamoto and apply an oxidation process for the benefit of providing a better quality for multilayered high – k dielectric materials as taught by Raaijmakers in paragraphs 9 – 11.

Regarding claims 7, 10, 16 and 23, Halliyal teaches hafnium silicate as a suitable high – k dielectric material in column 6, line 27.

Conclusion

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Asok K. Sarkar whose telephone number is 571 272 1970. The examiner can normally be reached on Monday - Friday (8 AM- 5 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kammie Cuneo can be reached on 571 272 1957. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

8. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Asok Kumar Sarkar

Asok K. Sarkar
June 21, 2004

Patent Examiner